Bonner zoologische Beiträge	Band 52 (2004)	Heft 1/2	Seiten 127–147	Bonn, August 2004

Notes on the Bats (Chiroptera) Collected by the Joint Ethiopian-Russian Biological Expedition, with Remarks on Their Systematics, Distribution, and Ecology

Leonid A.LAVRENCHENKO[1)], Sergei V. KRUSKOP[2)] & Petr N. MOROZOV[1)]
[1)] A. N. Severtsov Institute of Ecology and Evolution RAS, Moscow, Russia
[2)] Zoological Museum of Moscow State University, Moscow, Russia

Abstract. New records are reported for 30 species of Ethiopian bats collected by the Joint Ethiopian-Russian Biological Expedition. *Myonycteris torquata* and *Pipistrellus aero* are recorded for the first time from Ethiopia. Principal new localities are reported for ten species, including *Stenonycteris lanosus*, *Lissonycteris angolensis*, *Hypsignathus monstrosus*, *Micropteropus pusillus*, *Nycteris thebaica*, *Triaenops persicus*, *Myotis scotti*, *M. welwitschii*, *Pipistrellus rusticus* and *Laephotis wintoni*. Selected external and cranial measurements, information on habitat associations and reproduction are given for most species. Generally, the local faunas of Microchiroptera of Ethiopian montane forests are impoverished. Nevertheless, both of the only known endemic species, *Myotis scotti* and *Plecotus balensis*, being putative derivatives of Palaearctic lineages, inhabit this environment. A checklist of 77 bat species known to date from the territory of Ethiopia is provided in the Appendix.

Key words. Systematics, biogeography, biodiversity, Ethiopia.

1. INTRODUCTION

The bat fauna of the African continent has been investigated for many decades. However, despite the huge collection material deposited in various museums, our knowledge about African bats still is very fragmentary. Most of the recent expeditions have yielded new faunistic records (BAETEN et al. 1984; RAUTENBACH et al. 1985; CLAESSEN & DE VREE 1991; HELLER et al. 1994), and sometimes even species new to science (e.g. KOCK et al. 2000; EGER & SCHLITTER 2001; FAHR et al. 2002).

Ethiopia reflects the situation of bat investigations in the Afrotropics in general. A full checklist of Ethiopian bats was first compiled in the 1970-s (LARGEN et al. 1974), and subsequently supplemented by new findings (YALDEN et al. 1996). Although this list of species seems to be fairly complete, the possibility of discovering species new to the country, and/or new to science, persists. The territory of the country is not entirely surveyed, especially taking into account its geographical heterogeneity. Ethiopia occupies a unique geographical position between East and North Africa, thus its fauna demonstrates a combination of Afrotropical and southern Palaearctic elements. Most of the territory of the country is covered with mountain massifs, separated from each other by lowlands, including the Rift Valley, which is the main zoogeographical barrier within the country. In accordance with this geomorphological diversity, the Ethiopian fauna is characterised by a high level of endemism. At present, 34 mammalian species are considered to be endemic to Ethiopia (YALDEN et al. 1996; KRUSKOP & LAVRENCHENKO 2000; LAVRENCHENKO 2003) and this list probably is not final. Thus, further investigations of the bat fauna seem to be necessary, as well as the publication of the data already collected.

During the past several years, series of bats were collected by the Joint Ethiopian-Russian Biological Expedition; some of them were subsequently transferred to the Zoological Museum of the Moscow State University. This collection contains, amongst others, some new faunistic findings at localities considerably distant from previously known sites, and also some interesting species which are rare in scientific collections. One specimen from this material was used as the holotype for the description of a new species (KRUSKOP & LAVRENCHENKO 2000). The taxonomic position of some bats is doubtful and needs further revision.

2. MATERIAL AND METHODS

The codens used for institutions in which the voucher specimens are deposited are as follows: BMNP - Bale Mountains National Park Museum, Dinshu, Ethiopia; HZMS - Harrison Zoological Museum, Sevenoaks, Kent, UK; MRAC - Koninklijk Museum voor Midden-Afrika, Tervuren, Belgium; LIVM - Liverpool Museum, UK; HSUE - Natural History Museum, Addis Ababa, Ethiopia; ZMAS - Zoological Museum of St. Petersburg Zoological Institute, Russia; ZMUM - Zoological Museum of Moscow State University, Russia.

The material came from the following 14 localities (mapped in Fig. 1):

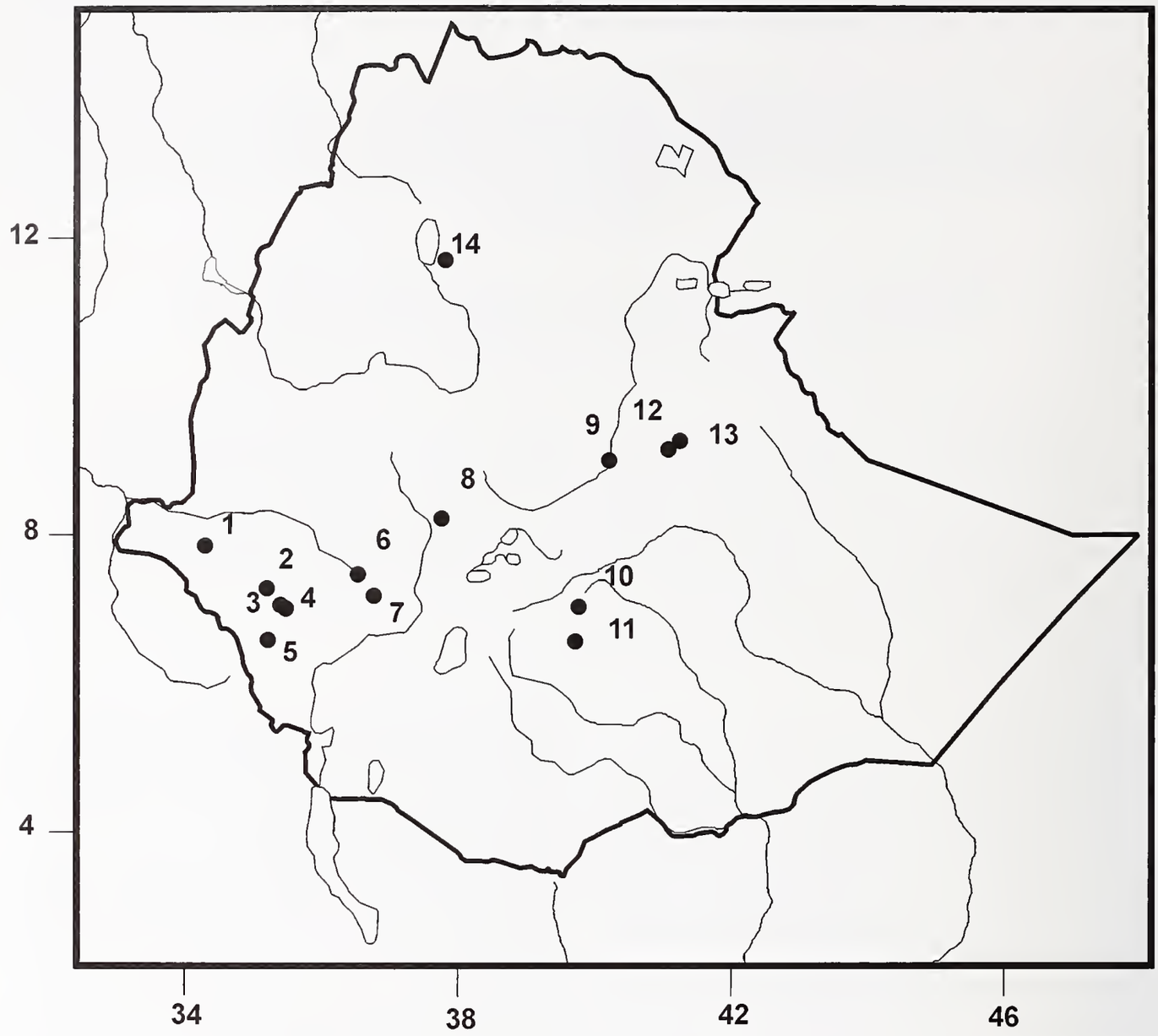

Fig. 1: Map of Ethiopia showing localities from which bats were collected during this study. The names, co-ordinates and altitudes of these localities are given in the text.

1. Gambela, Middle Alvero Valley, 30 km W of Abobo, and Tata Lake — 07°55'N 34°19'E, 440 m ASL

2. Godare Forest, Dushi Area, Yamboshi River — 07°21'N 35°13'E, 1200 m ASL

3. Beko River, between Mizan-Teferi and Tepi, and 3a. Beko River's tributary – 07°07'N 35°25'E, 1300 m ASL

4. Sheko Forest – 07°04'N 35°30'E, 1930 m ASL

5. Koi River, 37 km SW of the Bebeka Coffee Farm – 06°39'N 35°14'E, 1130 m ASL

6. Beletta Forest, 38 km SW of Jimma – 07°32'N 36°33'E, 2050 m ASL

7. Middle Godjeb Valley – 07°15'N 36°47'E, 1220 m ASL

8. Welkite – 08°17'N 37°47'E, 2070 m ASL

9. 15 km NE of Awash settlement – 09°04'N 40°14'E, 1000 m ASL

10. Bale Mountains National Park, Dinshu Hill – 07°06'N 39°47'E, 3170 m ASL

11. Bale Mountains National Park, Harenna Forest: Shawe River – 06°38'N 39°44'E, 1935 m ASL and 11a. Shisha River – 06°27'N 39°44'E, 1680 m ASL

12. Hirna – 09°13'N 41°06'E, 1940 m ASL

13. Chercher Mountains, between Hirna and Deder – 09°20'N 41°16'E, 2700 m ASL

14. Vanzaye, shore of the Gumara River, 43 km NE of Bahr-Dar – 11°47'N 37°43'E, 1750 m ASL

Geographic co-ordinates were taken using maps of the Ethiopian Mapping Agency (1979) published by the Topographic Centre, Washington.

At all trapping sites, we used mainly fine thread mist-nets set across presumed bat flyways: forest paths, small streams and cave entrances. We used four-shelved mist nets, 7×2 metres, with mesh size 1.6 mm. Visual observations were conducted at dusk and at night with the aid of electric torches and a QMC mini narrow-band heterodyne ultrasound detector (the latter was used only during the work in Bale Mountains National Park). Data of field observations of selected species were provided only in cases when observed individuals originated from aggregations (e.g., roosting colonies) from which reference material was available. Because bats were not the main study object in some of the expeditions and, eventually, were collected as a "by-product" of surveys of other mammal groups, the recorded data on the habitat and circumstances of their capture is not always uniformly detailed. Hence, in the following text such information is represented mainly for poorly known species or in cases when it differs from previously published data. The following external measurements were taken by digital callipers to the nearest 0.1 mm: B – body length (from tip of muzzle to anus); T – tail length (from anus to last vertebra); FA – forearm length; EAR – ear length from the lower border of the external auditory meatus (posterior to the tragus) to the tip of the pinna; HF – hind foot length (excluding claws). Most of the external measurements were taken post-mortem from freshly sacrificed specimens, with the exception of Megadermatidae and Nycteridae species, which where measured in museum collections. Cranial and dental measurements were measured with electronic callipers to the nearest 0.01 mm and included: TLS – total length of skull (distance between front of canine and occiput in species belonging to Rhinolophidae *s. l.* and distance between the anterior alveolus margin of I1 and the occiput in the case of other families); CCL – condylocanine length (distance between front of canine and ipsilateral condylus occipitalis); POC – postorbital constriction; MW – mastoid width (between the outermost extremities of the base of the skull at the level of the auditory bulla); CC – canine width (between outer margins of upper canines); MM – molar width (between outer margins of posterior upper molars); CM3 – length of maxillary toothrow (at outer crowns); ML – length of mandible (distance between I_1 alveolus margin and articular process). Two additional measurements: C – length of upper canine cingulum, and OH – height of the occiput, were used for determination of *Pipistrellus* species. Selected specimens were weighed to the nearest 0.1 g (W). In selected cases, principal component analyses (PCA) were performed on standardised cranial measurements using the Factor Analysis Module of the statistical package STATISTICA 5.11 (StatSoft, Inc.) for confirmation of identification.

We also considered useful to provide lists of specimens used as comparative material in some problematic cases, in addition to the lists of Ethiopian specimens themselves. Unfortunately, some species are represented by specimens fixed in formalin (e.g. specimens of *Neoromicia capensis*) or which spent a long time in fixative (e.g. *Nycteris* and Megadermatid species), and their conditions do not allow to extract skulls without serious risk to damage them. Because of these circumstances we do not provide cranial measurements for several species.

3. SPECIES RECORDS, DISTRIBUTION, TAXONOMIC AND ECOLOGICAL NOTES

Rousettus aegyptiacus (E. Geoffroy, 1810)

Material: Bale Mountains National Park, Harenna Forest, Shawe River, 11-14 January 1996, 2 adult females, 1 embryo; Beletta Forest, 38 km SW of Jimma, 3 May 1997, 1 subadult female; Beko River, between Mizan-Teferi and Tepi, 25 March 1999, 1 adult female, 1 adult male; 07 October 2000, 1 adult male; Western Hararge, Hirna, 19 September 2000, 1 adult male (3 in alcohol, 4 skins with skulls, 1 embryo in alcohol, ZMUM S-165176, 165179, 165372, 165534, 167277-278, 168981-982).

Ecological remarks: In the Harenna Forest, the animals were captured in primary evergreen forest over a stream. Both adult females were pregnant: one was at the early stage of pregnancy, while the other contained a well developed embryo.

In March 1999, a huge colony of this species was found under the bridge across the Beko River. This bridge is ca. 20 m long and is made of 20 concrete orthogonal sections. The height above the water is about 8 meters. While the lateral sections were inhabited by just 100-200 individuals each, the other sections were filled entirely by hundreds of animals. The whole colony contained about 10,000 individuals of both sexes. Amongst the masses of adults, there were "kindergartens" – conspicuous aggregations of blackish juveniles and pink neonates. Some neonates constantly kept with females and were carried by them from place to place. Young animals from the "kindergartens" relatively frequently fell down from the bridge ceiling. In this case, half-grown animals glided to the wall of the construction and then returned to the colony; younger individuals were carried away by the water current (5 animals per hour on average). About 30 minutes before sunset, activity in the colony began to increase: sounds produced by individual bats merged together; ca. 100 animals were observed flying simultaneously under the bridge. Within 15-20 minutes of sunset, most adults left the roost. Animals flew away along the river canyon, using it as the main path, and only a few bats were observed over the bridge.

Stenonycteris lanosus (Thomas, 1906)

Material: Bale Mountains National Park, Harenna Forest, Shawe River, 11-14 January 1996, 7 subadult and

adult females, 3 males; Beletta Forest, 38 km SW of Jimma, 8 April 1997, 1 adult female; 2-4 May 1997, 3 adult females, 1 adult male; 8-12 April 1998, 2 adult males (8 in alcohol, 9 skins with skulls, ZMUM S-165172-175, 165177-178, 165180, 165369-371, 165373-374, 165528-530, 165954-955).

Distribution remarks: This rousettine species was considered as relatively rarely captured (KINGDON 1974), and in Ethiopia it was found only in the Beletta Forest, Dorse, Affalo and somewhere in Shoa (LARGEN et al. 1974; YALDEN et al. 1996). However, we found this species to be one of the most common fruit-bats in the Harenna and Beletta Forests, where sometimes it was rather numerous. Amongst these sites, the Harenna Forest is a new locality for this species in Ethiopia and the first in this country situated to the east of the Rift Valley.

Taxonomic remarks: Although the current bat taxonomy usually includes the species *lanosus* in the genus *Rousettus* (e.g. KOOPMAN 1994), molecular data suggest that *Stenonycteris* may be a member of the endemic African clade, also including *Myonycteris*, *Megaloglossus* and *Lissonycteris*, but not *Rousettus* s. str. (ALVAREZ et al. 1999; JUSTE et al. 1999; ROMAGNOLI & SPRINGER 2000).

Ecological remarks: All individuals were collected in various types of Afromontane forest. Pregnant females were caught in the beginning of May and in the middle of January, suggesting at least an extended reproductive chronology (sensu HAPPOLD & HAPPOLD 1990) which may be bimodal.

***Lissonycteris angolensis* (Bocage, 1898)**

Material: Beletta Forest, 38 km SW of Jimma, 13 April - 4 May 1997, 6 adult females, 1 subadult and 7 adult males, 10 March - 8 April 1998, 1 subadult and 4 adult females, 1 subadult and 3 adult males; Bale Mountains National Park, Harenna Forest, Shisha River, 15 January 1996, 1 male; Southern Region, Sheko Forest, 23 March 1999, 1 adult male (19 in alcohol, 7 skins with skulls, ZMUM S-165353-366, 165531, 165949-953, 166093, 166095-097, 167281).

Distribution remarks: This fruit-bat was formerly known in Ethiopia only in Nur Mohammed and near the Didessa, Doki and Shisha Rivers (LARGEN et al. 1974; YALDEN et al. 1996). According to our data this species is more widespread in the south-western part of the country than known before.

Taxonomic remarks: *Lissonycteris* resembles another fruit bat, *Myonycteris*. Both are short-muzzled and their males have «collars» of elongated hairs. All our specimens have longer forearms (69-81 mm vs. 54-68 mm [KOOPMAN 1994]) and larger dental proportions than *M. torquata* which is widely distributed and the only *Myonycteris* species likely to occur in Ethiopia. *Lissonycteris*, treated as a subgenus of *Rousettus* by KOOPMAN (1994) and as a subgenus of *Myonycteris* by PETERSON et al. (1995), is somewhat intermediate between these two taxa. KINGDON (1974) and BAETEN et al. (1984) treated it as a separate genus, and this point of view is strongly supported by DNA analyses (JUSTE et al. 1997; ALVAREZ et al. 1999).

LARGEN et al. (1974) suggested that in Ethiopia *Lissonycteris* is represented by *L. a. ruwenzorii* (Eisentraut, 1965), but BERGMANS (1997) described a distinct subspecies from this region, *L. a. petrea*. All our specimens correspond to *petrea* in all measurements (only FA has a somewhat larger size variability) and on the average are smaller than *ruwenzorii*.

Differences in pelage colour were observed. Most of our specimens are more or less uniformly brown, with brown or reddish-brown collars. However, two adult males from the Sheko Forest and one from the Beletta Forest, are uniformly grey, almost without brown shades, with grey collars. We did not find any published description of such variation; it cannot be connected with geographical variability. Perhaps, the amount of brown in the coloration is correlated with the physiological state of the animals.

Ecological remarks: The specimens were caught in various forested areas - from *Podocarpus* forest to *Eucalyptus* and *Pinus* plantations. Females in the mid stages of pregnancy were captured at the end of April – beginning of May, but less than half of the adult females were pregnant.

***Myonycteris torquata* (Dobson, 1878)**

Material: Beletta Forest, 38 km SW of Jimma, 9 March 1998, 1 subadult male (1 in alcohol with extracted skull, ZMUM S-166094).

Comparative material: Guinea, Kindia, 17 July 1986, 1 male (1 in alcohol, ZMUM S-142370).

Distribution remarks: This is the first record of this otherwise widely distributed Western and Central African species in Ethiopia, ca. 500 km northeast from the previously known range.

Taxonomic remarks: *Myonycteris* seems to be the closest relative of *Lissonycteris* (see comments above), which is particularly corroborated by the fact that the specimen S-166094 was initially identified as a young *Lissonycteris angolensis*. However, a thorough comparison with other available specimens of the latter species confirms significant differences. The mentioned animal has a distinctly shorter forearm (64.8 mm vs. 69-81 in *Lissonycteris*, including subadult individuals). It also has smaller cranio-dental proportions (Fig. 2), except the postorbital breadth which is larger than in most of

the measured *L. angolensis*. The skull of S-166094 looks proportionally shorter than in *L. angoleusis*, but with wider frontal part, which is less depressed. It also differs in a having more bulbous braincase and narrower postdental palate. The tooth row is distinctly shorter, but the teeth themselves are of comparable size (cusp lengths of P4 and M1 2.49 mm and 2.03 mm vs. 2.09-2.53 mm and 1.87-2.38 mm respectively in *L. angolensis*), thus the whole tooth row looks more compressed than in *Lissonycteris*. Externally S-166094 differs in narrower muzzle and shorter and smoother pelage, which is especially evident on the throat. At the same time this individual looks similar to the *Myonycteris* specimen from Guinea, which differs by slightly more gracile constitution and smaller, but comparable size (forearm 60.4 mm, CM2 13.1 mm).

Specimen S-166094 corresponds to *Myonycteris torquata* as described by BERGMANS (1997) in most measurements, with the exception of molar width and upper tooth row length which are slightly larger, and distinctly smaller than *Lissonycteris angolensis petrea* and even than *M. relicta* Bergmans, 1980. It also possesses such qualitative features of *M. torquata* as almost naked distal third of tibia, unwebbed toes of hind foot and only slightly separated inner and outer ridges on large lower premolars.

***Hypsignathus monstrosus* H. Allen, 1861**

Material: Godare Forest, Dushi Area, Yamboshi River, October 2000, 2 adult females (1 in alcohol, 1 skin with skull, ZMUM S-168899-900).

Distribution remarks: This is the second record of the species in Ethiopia, previously known only from the Manera Forest (LARGEN et al. 1974). However, the latter record was questioned by BERGMANS (1989), who said that he could not find any reference material. Thus our specimens probably represent the first documented record of *Hypsignathus* from Ethiopia.

Ecological remarks: The captured individuals seemed to have come from a sparse aggregation distributed along the Yamboshi River in primary riverine forest. At least ten animals were recorded vocalizing at this locality.

***Epomophorus gambianus* (Ogilby, 1835)**

Material: Beletta Forest, 38 km SW of Jimma, 22 April 1997, 1 adult female; 2-4 May 1997, 1 adult female, 1 subadult male; 9-12 March 1998, 2 adult females; 8 April 1998, 2 females; left slope of the Godjeb River Valley, 18 March 1998, 1 adult female and 1 newborn male; Koi River, 37 km SW of Bebeka, 9-10 March 1999, 2 adult females, 1 juv. male; Godare Forest, Dushi Area, Yamboshi River, 07 October 2000, 1 adult female (10 in alcohol, 3 skins with skulls + 1 carcass in alcohol, ZMUM S-165367-368, 165375, 166089-092, 165945-946, 167227-228, 167276, 168894).

Comparative material: *Epomophorus wahlbergi* (Sundevall, 1846): Kenya, specific locality unknown, 1976, 2 females (2 in alcohol, ZMUM S-135804-805).

Taxonomic remarks: Most of our specimens had forearm lengths in the ranges exemplified by *Epomophorus gambianus* and *E. wahlbergi* (Tab. 1), but all individuals for which it was possible to examine the palatal ridges had two post-dental ridges (which is characteristic of *E. gambianus*) as opposed to one post-dental ridge (which distinguishes *E. wahlbergi* from all other species of *Epomophorus*) (Hayman & Hill 1971; Claessen & De Vree 1991).

Ecological remarks: The species was captured in montane (Beletta), lowland (Godare) and riverine (Godjeb, Koi) forests. Two females with newborns were captured in the middle of March. A single female in the mid stage of pregnancy was caught at the beginning of May.

***Micropteropus pusillus* (Peters, 1868)**

Material: 30 km W of Abobo, Alvero River, 440 m ASL, 29 November 1986, 1 adult male, 17 February 1987, 1 adult male; left slope of the Godjeb River Valley, 16-19 March 1998, 6 adult and 2 subadult males; Koi River, 37 km SW of Bebeka, 9-12 March 1999, 2 subadult females, 1 subadult male; Western Hararge, Hirna, 19 September 2000, 2 adult females; Southern Region, Sheko Forest, 5-23 March 1999, 2 adult females (14 in alcohol, 3 skins with skulls, ZMUM 163596-597, 165959, 166082-088, 167214-216, 167279-280, 168920-921).

Distribution remarks: The specimen from Hirna is the first record from that part of Ethiopia which is east of the Rift Valley. Furthermore, Hirna is now the most easterly locality in the known geographic range of this species.

Ecological remarks: This species was captured in open woodlands, riverine and montane forests. One lactating female was captured in the middle of September.

***Cardioderma cor* (Peters, 1872)**

Material: Awash National Park, 15 km NE of Awash settlement, 17 July 1994, 1 adult female (1 in alcohol, ZMUM S-163600).

Ecological remarks: The single specimen was caught in a rodent snap-trap placed on the ground in *Acacia* savanna. According to VAUGHAN (1976) and CSADA (1996), *Cardioderma cor* takes most of its prey directly off the ground (at least during the dry season) and flightless arthropods probably make up a large part of its diet. The female was pregnant with a single embryo (crown-rump length: 32 mm).

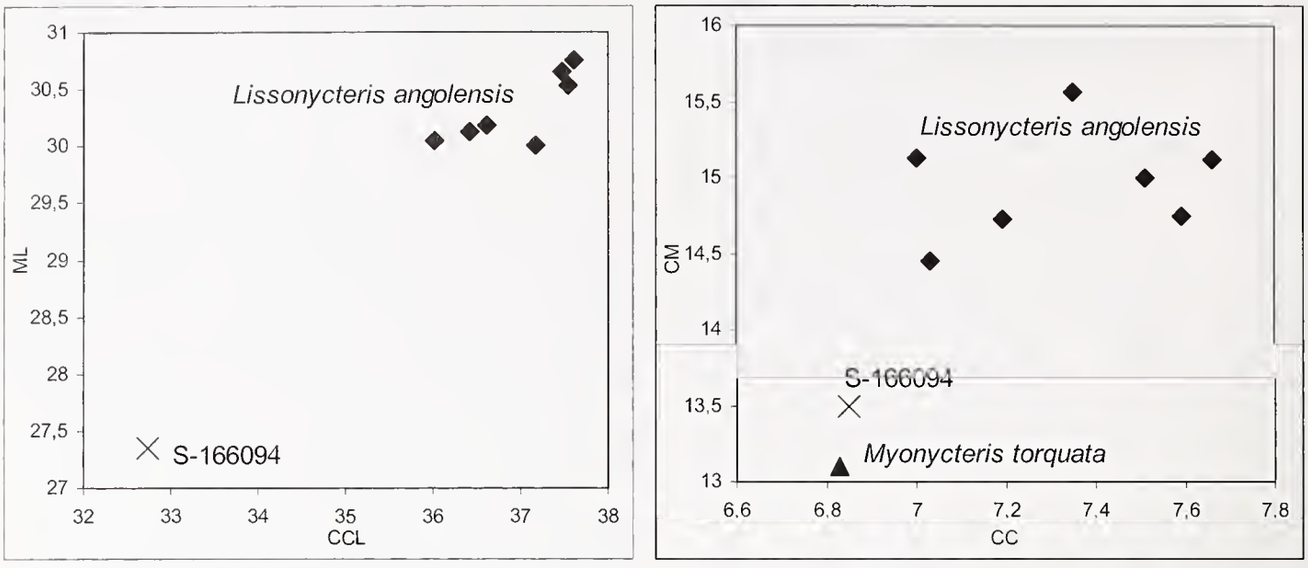

Fig. 2: Correspondence between specimen S-166094, determined as *Myonycteris torquatus*, and Ethiopian *Lissonycteris angolensis* in some skull measurements: a – condylocanine length of skull (CCL) and length of mandyble (ML); b – canine width (CC) and upper tooth row (CM). Additional specimen on diagram (b) is *Myonycteris torquata* from Guinea.

***Lavia frons* (E. Geoffroy, 1810)**

Material: 30 km W of Abobo, Alvero River, 29 November - 19 December 1986, 2 adult females (2 in alcohol, ZMUM S-163598-599).

Ecological remarks: Both females were netted in riverine forest. One of them had an embryo with a crown-rump length of 3.5 mm.

***Nycteris hispida* (Schreber, 1774)**

Material: Gambela, Alvero Valley, 30 km W of Abobo, 27 December 1986, 1 adult female; Lake Tata, 15 February, 07 March 1987, 1 adult female, 1 adult male (3 in alcohol, ZMUM S-170389-391).

Taxonomic remarks: VAN CAKENBERGHE & DE VREE (1993) demonstrated that there are two similar species in the complex, which are sympatric in some places. All our specimens most probably represent *N. hispida* based on smaller dental measurements (CM3 5.6-5.7 mm vs. 4.6-6.7 mm in *N. hispida* and 5.7-6.2 mm in *N. aurita*; CC 3.8-4.1 mm vs. 3.5-4.8 mm and 4.1-4.8 mm) and also their relatively small size and shorter ears (ca. 19 mm). *N. hispida* is a rather common species in Gambela (from where our specimens originated), while the other species, *N. aurita* (Andersen, 1912), was undoubtedly reported for Ethiopia only once (YALDEN et al. 1996). Despite the postulated partial sympatry, KOOPMAN (1994) treated *N. aurita* as a synonym of *N. hispida*.

***Nycteris macrotis* Dobson, 1876**

Material: Gambela, Alvero valley: 20 km W of Abobo, 27 December 1986, 1 adult male (1 in alcohol, ZMUM S-170392).

Ecological remarks: The specimen was caught in a rodent snap-trap placed on the ground in woodland dominated by deciduous trees. This suggests that the species sometimes captures its prey on the ground.

***Nycteris thebaica* E. Geoffroy, 1818**

Material: Gambela, Alvero valley: 30 km W of Abobo, 25 January 1987, 1 subadult male (1 in alcohol, ZMUM S-170388).

Distribution remarks: This new record is the westernmost locality for this species in Ethiopia.

***Rhinolophus clivosus* Cretzschmar, 1828**

Material: Bale Mountains National Park, Harenna Forest, Shawe River, 11 January 1996, 1 adult male (1 in alcohol, ZMUM S-165533).

Comparative material: *Rhinolophus clivosus*: Kenya, Western Province, Trans Nzoia District, 26-30 December 1980, 1 adult female, 2 adult males; Uganda, Kisoro, Kabale, 04 January 1960, 1 adult male (4 in alcohol, 1 extracted skull, ZMUM S-129769-771, 162092).

Taxonomic remarks: Our specimen is relatively small for *R. clivosus* (forearm 49.5 mm) and superficially somewhat resembles *R. darlingi* Andersen, 1905. It also differed in some ways from specimens identified as *R. clivosus* in ZMUM. In comparison with the Ugandan individual (S-162092), it has a higher connecting process and longer and more hastate lancet; in comparison with Kenyan specimens it has a wider anterior noseleaf and a higher and less pandurate sella. From all of them the Ethiopian specimen differs in distinctly more brow-

nish pelage coloration (which, however, may by a result of discoloration in alcohol). However, comparison with the specimens identified as *R. clivosus* in HZMS led the senior author to identify our material as belonging to this species. Our specimen has a distinctly hastate lancet, making it unlikely to represent *R. darlingi* which, although very similar externally and in size, has a subtriangular lancet and has not yet been recorded from Ethiopia. The skull of our specimen possesses well developed upper small premolars, although strongly extruded from tooth rows. Basisphenoid bones extend anteriorly from the glenoid fossae. Both features are characteristic of the members of the "*ferrumequinum*" species group, in opposition to similar-sized *Rh. fumigatus* and its relatives (COTTERILL, 2002). Rostral swellings in S-165533 are relatively small and almost equal in height to the posterior part of rostrum. *Rh. clivosus* on the whole seems to be a very variable and complex species, with a southward cline in size increase along its distribution area (THOMAS 1997, cit. after COTTERILL, 2002), and the features of the Ethiopian specimen more or less correspond with its variation.

Ecological remarks: This individual was captured at dusk in a mist net placed over a stream under a stone bridge. No horseshoe bats were found under this bridge when it was examined during the day.

***Hipposideros ruber* (Noack, 1893)**

Material: Southern Region, tributary of the Beko River, 18-19 March 1999, 3 adult females; Godare Forest, Dushi Area, Yamboshi River, 10 October 2000, 1 adult female, 1 adult male (2 in alcohol, 3 skins with skulls, ZMUM S-167287-289, 168897-898).

Taxonomic remarks: Relationships between *H. ruber* and *H. caffer* (Sundevall, 1846) are uncertain and need further investigation (KOOPMAN 1965; HILL & MORRIS 1971; BAETEN et al. 1984). Some authors (HAYMAN & HILL 1971; FENTON 1975) give size limits of the forearm length at 48 mm (less for *H. caffer*, and more for *H. ruber*). KOOPMAN (1994) documented higher variation resulting in some overlap in size between these two species. KONSTANTINOV et al. (2000) provide a forearm length for adult *H. caffer* from 40 to 56 mm. However, given the diagnostic characters of Guinean *Hipposideros* (FAHR & EBIGBO 2003) the authors very likely possessed a mix of several species, and their results need reassessment. The coloration of adult *H. caffer* is described as grey to black (BAETEN et al. 1984), or greyish to pale orange (FENTON 1975), while the pelage of *H. ruber* is brown to rufous. Differences in morphology of the narial complex do not seem to be reliable as a means of distinguishing these species.

Both species are known from Ethiopia (HILL & MORRIS 1971; YALDEN et al. 1996). Our specimens have forearm length larger than 50 mm (Tab. 1). Dimensions of measured skulls are on the margin between the two species (Tab. 2), but are slightly larger than those of *H. ruber* from Liberia. All mentioned specimens are brown or reddish-brown.

Ecological remarks: All specimens were captured in evergreen forest. This corresponds with the opinion that *H. ruber* is a species of forested and relatively wet areas (KINGDON 1974). On the tributary of the Beko River a small colony of this species of at least 15 individuals was found under a bridge ceiling.

***Hipposideros caffer* (Sundevall, 1846)**

Material: Left slope of the Godjeb River Valley, 18 March 1998, 1 adult male; Vanzaye, shore of the Gumara River, 6 December 2001, 1 adult female, 4 adult males (3 in alcohol, 3 skins with skulls, ZMUM S-166081, 172695–699).

Taxonomic remarks: These individuals are distinctly smaller than the above mentioned specimens of *H. ruber*. Their forearm length (47.8–50.6 mm) entirely complies with that of *H.* cf. *caffer* from Guinea as reported by FAHR & EBIGBO (2003). They have distinctly a smaller canines width and somewhat narrower nose leaves than Ethiopian *H. ruber*. Three of these specimens have a greyish pelage, and one individual is pale orange and distinctly paler than specimens of *H. ruber*. However, grey pelage coloration can also be found in subadult *H. ruber* (BAETEN et al. 1984); ROSEVEAR (1965) also notes more greyish coloration in young individuals of all forms comprising the *H. caffer* complex.

Ecological remarks: The individual from the Godjeb Valley was captured under a bridge used as day roost by a small group of these bats. It is noteworthy that the locality was situated in tall-grass savanna with *Acacia*, *Combretum* and *Terminalia*; KINGDON (1974) noted that *H. caffer* is a savanna species while *H. ruber* is more or less restricted to forested areas.

***Triaenops persicus* Dobson, 1871**

Material: Godare Forest, Dushi area, Yamboshi River, 10-12 October 2000, 2 adult females, 2 adult males (3 in alcohol, 1 skin with skull, ZMUM S-168983-986).

Distribution remarks: This new record is the westernmost locality of this species in Ethiopia.

***Myotis scotti* Thomas, 1927**

Material: Beletta Forest, 38 km SW of Jimma, 21 April 1998, 1 adult male; Southern Region, tributary of the Beko River, 18-19 March 1999, 3 adult females, 1 adult male (2 in alcohol, 3 skins with skulls, ZMUM S-165958, 167225-226, 167284-285).

Distribution remarks: The second of these new records represents the westernmost locality of this species which is endemic to Ethiopia.

Ecological remarks: The specimens were collected in humid Afromontane forest. All three females were pregnant, with one embryo each.

Myotis welwitschii **(Gray, 1866)**

Material: Beletta Forest, 38 km SW of Jimma, 10 March 1998, 1 adult male; 2 April 1998, 1 adult female (2 skins with skulls, 1 carcass in alcohol, ZMUM S-165947-948).

Distribution remarks: Our record of this poorly known species is one of the three already made in Ethiopia but not very distant from previous record in Afallo (FAHR & EBIGBO 2003).

Ecological remarks: These specimens were collected in secondary evergreen montane forest. Animals were knocked down with a long pole while they were slowly hawking over the ground in a forest opening.

Plecotus balensis **Kruskop & Lavrenchenko, 2000**

Material: Bale Mountains National Park, Harenna Forest, 29 December 1995, 1 adult male (1 skin with skull, carcass in alcohol, ZMUM S-164904).

Comparative material: *Plecotus balensis*: locality unknown ("Abyssinia" = Ethiopia; probably vicinity of Addis-Ababa), 2 adult males; Bale Mountains National Park, Harenna Forest, 4-19 August 1986, 2 adult males and 3 females (5 in alcohol, 1 skin with skull, 1 skin without skull, ZMAS 8825, 66732, BMNP 244 , LIVM 1986.212.61-64).

Taxonomic remarks: Until recently *Plecotus austriacus* was the only known member of the genus in Africa (CORBET 1978; KOOPMAN 1994) and Ethiopian specimens were assigned to this species (YALDEN et al. 1996). Investigation of the long-eared bats collected in Ethiopia, mainly in the Bale Mountains, enabled us to allocate them to a separate species, *Plecotus balensis* (Kruskop & Lavrenchenko 2000). It differs from *P. austriacus* (Fischer, 1829) in having a smaller skull, dark coloration and a differently shaped baculum. Bacular morphology and size are known to be a reliable means of distinguishing species of *Plecotus* (e.g. STRELKOV 1989). Despite the difference of the mentioned species from *P. austriacus* s. l., recent fragmentation of the latter complex into several species, with the description of some new forms (KIEFER & VEITH 2002, SPITZENBERGER et al. 2002, 2003) provides for the necessity of a reassessment of taxonomic relations of *P. balensis*.

Distribution remarks: This newly described species, endemic to Ethiopia, is currently only known from the upper belt of the Harenna Forest on the Bale Mountains, from 2500-3000 m ASL.

Ecological remarks: According to sight records, this species seems to be a relatively common bat in humid Afromontane *Schefflera-Hagenia* and *Erica arborea* forest. The preferred foraging places are relatively open parts of the forest, and the edges of clearings, where both slowly hawking and perch-hunting activities were observed. Although the bats emitted audible (communication?) calls, very similar to such calls emitted by European long-eared bats, we failed to detect their echolocation signals with a QMC-mini narrow-band heterodyning detector, suggesting that the signals are of very low intensity.

Pipistrellus hesperidus **(Temminck, 1840)**

Material: Western Hararge, between Hirna and Deder, 24-25 September 2000, 4 adult females, 6 adult males (10 in alcohol, 9 extracted skulls, ZMUM S-168932-934, 168936-939, 168941-943).

Comparative material: *Pipistrellus kuhlii* (Kuhl, 1817): Sahara (exact locality is unknown), 1903, 2 females, 1 male; Armenia, April 1949, 1 adult male; Azerbaijan, 23 April 1975, 1 adult male; Russia, Krasnodarskii Krai, Tuapse, 13 August 1998, 1 male, 1 female; Krasnodarskii Krai, Adler, 3-10 August 1999 (4 in alcohol with extracted skulls, 5 skins with skulls, ZMUM S-108421-22, 108425, 108431, 149478, 166216-17, 167378-79).

Taxonomic remarks: Two specimens (S-168936, 168942) were kindly investigated by Dr. Victor Van Cakenberghe and identified by him as *Pipistrellus kuhlii fuscatus* (Thomas, 1901). However, *kuhlii*-like pipistrelles from sub-Saharan Africa are now considered as a distinct species, *P. hesperidus* (KOCK 2001); this point of view is supported by karyological data (KEARNEY et al. 2002). All our specimens differed significantly from *P. kuhlii* in having relatively dark fur and skin coloration, lack of any white margin on wing membranes and somewhat smaller skull measurements. Moreover, they are distinguished from *P. kuhlii* by the first two principal components extracted from the PCA analysis conducted on the basis of cranial measurements (Fig. 3). These pipistrelles have unicuspid upper incisors, both inner and outer (while at least part of *P. kuhlii* possess supplementary cusps on inner incisors). The outer incisor is much reduced, less than ½ of the inner incisor in crown area and only slightly exceeds its cingulum in height. Small upper premolar also greatly reduced, strongly compressed between large premolar and canine, almost not seen in lateral view.

Pipistrellus aero **Heller, 1912**

Material: Southern Region, tributary of the Beko River, 18-19 March 1999, 2 adult females; Godare Forest, Dushi area, Yamboshi River, 10-13 October 2000, 1 su-

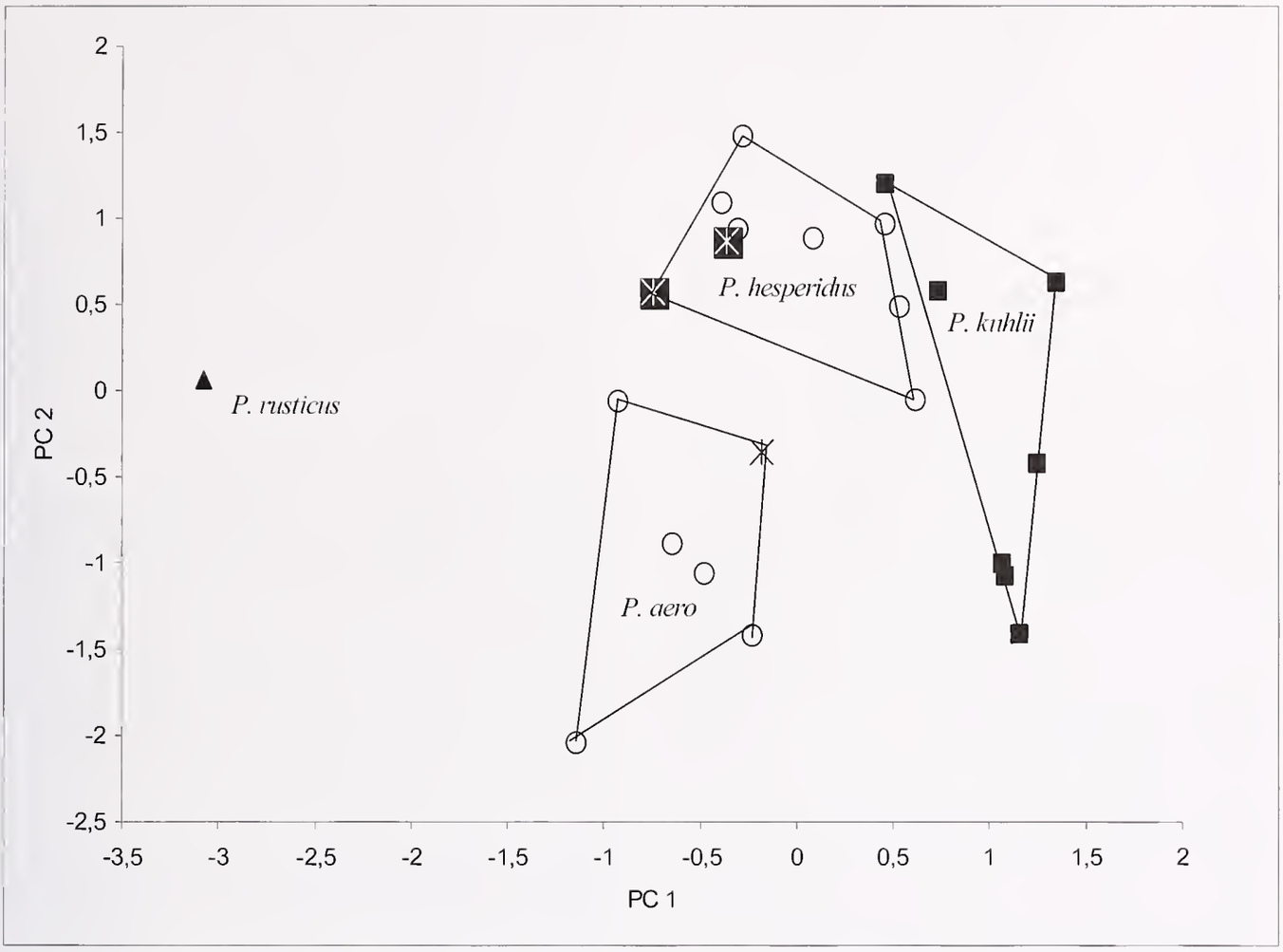

Fig. 3: Bivariate scatter plot of relative positions of specimens of *Pipistrellus* species in the plane of the first two principal components, calculated on the basis of 10 cranial measurements. PC 1 (Eigenvalue 6.904, 69.043% of total Variance) is highly correlated with cranial lengths, C and CM^3; PC 2 (Eigenvalue 1.608, 16.075% of total Variance) is correlated with MW and POC. Individuals identified by Dr. V. Van Cakenberghe are marked by asterisks. Variables included and specimens are listed in the text.

badult and 2 adult females, 1 adult male; Western Hararge, between Hirna and Deder, 25 September 2000, 1 adult male, 1 adult female (8 in alcohol, 6 extracted skulls, ZMUM S-167219, 167221, 168926-928, 168930, 168935, 168940).

Taxonomic remarks: One specimen, S-167221, originating from the tributary of Beko River was investigated by Dr. Victor Van Cakenberghe and identified by him as *P. aero*. Additional specimens with similar skull measurements (with CCL usually less than 12.1 mm, MW less than 7.5 mm) were clearly separated from *P. kuhlii* and *P. hesperidus* by the PCA (Fig. 3). In general characters as well as skin and pelage coloration these animals resemble *P. hesperidus*. Skull looks less robust than in *P. hesperidus*, with less robust rostrum and lower occipital part. Upper incisors, as in *P. hesperidus*, are unicuspid, outer incisor is much reduced, less than ½ of inner incisor in crown area and only slightly exceeds its cingulum in height. Small upper premolar very small, strongly compressed between canine and large premolar, but usually partially seen in lateral view. The baculum in general shape is similar to that of *P. kuhlii* (Fig. 4).

Distribution remarks: The species was previously reported only from north-western Kenya (HAYMAN & HILL 1971; KOOPMAN 1993, 1994). Our current records of *P. aero* in western and eastern parts of Ethiopia at distinct altitudes (1200-2700 m ASL) suggest that this species new to the country is probably widely distributed throughout its territory.

Pipistrellus rusticus (Tomes, 1861)

Material: Left slope of the Godjeb River Valley, 16 March 1998, 2 adult males; Southern Region, tributary of Beko River, 18-19 March 1999, 1 adult female; Godare Forest, Dushi Area, Yamboshi River, 10 October 2000, 1 subadult female; Koi River, 37 km SW of Bebeka, 11 March 1999, 2 adult females (6 in alcohol, 1 extracted skull, ZMUM S-166079-080, 167220, 167223-224, 168931).

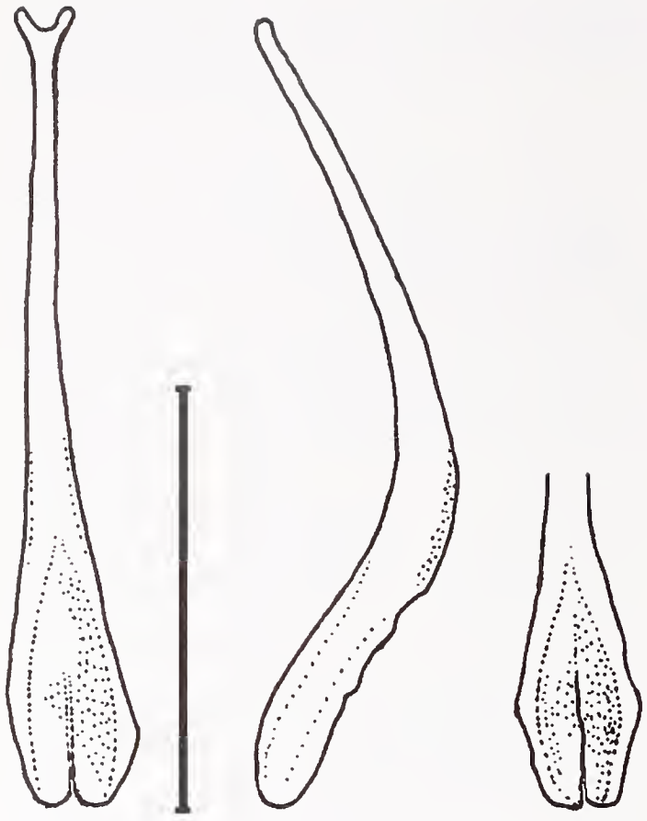

Fig. 4: Baculum of *Pipistrellus aero* S-168926: dorsal and lateral (left side) view and ventral view of the basal part. Scale bar 1 mm.

Distribution remarks: These new records demonstrate that this species is much more widespread in the south-western part of the country than was previously thought.

***Neoromicia capensis* (A. Smith, 1829)**

Material: Beletta Forest, 38 km SW of Jimma, 17-27 April 1997, 3 adult males (3 in alcohol, ZMUM S-164969-971).

Comparative material: *Neoromicia capensis*: Congo (K.), Boende, 1967, 1 adult male, 1 subadult male, 1 adult female, 2 subadult female; Congo (K.), Yetsi, August 1972, 1 subadult male; Kongo (K.), Wafanya, 5 December 1987, 1 adult male; Buta, ?, 1 adult female (8 in alcohol, MRAC 75035M24-25, 75035M57, 38717-18, 38725, 12590, 88005).

Taxonomic remarks: Pipistrelles of the «*capensis*» group have myotodont lower molars, a feature described by MENU (1987) who considered it to be of great taxonomic importance. The combination of "pipistrelloid" and "eptesicoid" morphological traits makes this group one of the "hot spots" in the taxonomy of Vespertilionidae. Many authors placed these bats in *Eptesicus* (e.g. KOOPMAN 1993) from which they differ by chromosome numbers (MCBEE et al. 1987) and facultative presence of upper small premolars (they are present in all three above mentioned individuals). For «*capensis*» ROBERTS (1926) proposed the name *Neoromicia*, which is now often considered as a subgenus of *Pipistrellus* (e.g. HILL & HARRISON 1987; KOOPMAN 1994). Based on dental characters, MENU (1987) described the genus *Nyctericaupius*, which, amongst others, includes «*P.*» *capensis*. By its myotodont teeth, and, to some extent, by bacular shape (HILL & HARRISSON 1987), *Neoromicia* resembles *Hypsugo*, but is closer to *Pipistrellus* according to karyological data (VOLLETH & HELLER 1994). However, *Neoromicia*'s undoubted differences from «typical» *Pipistrellus* as well as new karyological studies induced VOLLETH et al. (2001) to raise *Neoromicia* to generic rank (KEARNEY et al. 2002).

***Neoromicia cf. guineensis* (Bocage, 1889)**

Material: Koi River, 37 km SW of Bebeka, 10 March 1999, 1 adult female; Godare Forest, Dushi Area, 13 October 2000, 1 adult female (2 in alcohol, ZMUM S-167222, 168929).

Taxonomic remarks: The specimen S-167222 was kindly examined by Dr. Paul Bates and considered to be *Pipistrellus guineensis*. We accepted this provisional identification until the investigation of additional material. The two specimens resemble *N. guineensis* in size and also in having myotodont lower molars. However, they differ in having a peculiar tragus shape, its tip somewhat protruded forward and the posterior margin possessing a prominent angle. This "hatchet-like" shape of tragus was treated by HAYMAN & HILL (1971; also FENTON 1975; RAUTENBACH et al. 1985) as characteristic of *Pipistrellus nanus* only, but they did not include in their identification keys «pipistrelles» with uncertain taxonomic position. Our specimens differ well from *P. nanus* at least in the morphology of lower molars (which are nyctalodont in *P. nanus*). Both specimens have more or less bicuspid inner upper incisors; the outer incisors also possess a small secondary cusp and are 2/3 of inner in height and equal in crown area. Anterior upper premolars are present in both specimens (which is rather a trait of *Hypsugo* than *Neoromicia*), small, intruded and not seen in lateral view. Unfortunately, we possess only females and were unable to analyse bacular features, which are quite species-specific in most of African "pipistrelles" (HILL & HARRISON 1987; KEARNEY at al. 2002).

Distribution remarks: Both of our records were made in western part of Ethiopia, not very far from one of the previous records of *N. guineensis* in Gambela (LARGEN et al. 1974).

***Hypsugo* sp.**

Material: Beletta Forest, 38 km SW of Jimma, 01 April 1998, 1 adult female (1 in alcohol with skull extracted, ZMUM S-166078).

Taxonomic remarks: This individual distinctly differs from the two previously mentioned specimens of *N.* cf. *guineensis* by larger size (FA 34.1 mm) and darker coloration. The dark basal parts of the hairs in this specimen are much longer than the pale distal parts. Wing membranes and naked parts of skin are dark-brown, compared with relatively light-brown in *N. guineensis*. At the same time, the myotodont lower molars and bent anteriorly, somewhat hatchet-shaped tragus allow to refer this individual to *Hypsugo*. Inner upper incisors are weakly bicuspid, with reduced posterior cusp; outer incisors are unicuspid, reaching ca. 2/3 of inner incisors. Anterior upper premolar is well-pronounced, displaced inward from tooth row but well-seen in lateral view through the gap between posterior premolar and canine. In general size and coloration this specimen resembles pipistrelles of the "*kuhlii*" group (*Pipistrellus hesperidus* and *P. aero*). Anyhow, it demonstrates a combination of features, not yet described for any Ethiopian bat species. Amongst African pipistrelle-like species, possessing two upper premolars and myotodont lower molars, only *H. anchietae* and *H. eisentrauti* have a similar forearm length, but most cranial measurements of the latter species are distinctly larger (HELLER et al. 1994).

Laephotis wintoni Thomas, 1901

Material: Beletta Forest, 38 km SW of Jimma, 9 and 27 March 1998, 2 adult males (2 skins with skulls, ZMUM S-165956-957).

Distribution remarks: *Laephotis* is one of the most poorly known African vespertilionids. *Laephotis wintoni* has a large distribution range, however, it is encountered only sporadically, and represented in museum collections by a very limited number of specimens (PETERSON 1971; HILL 1974; RAUTENBACH et al. 1985). In Ethiopia, this species was previously known only from one locality near the Lake Koka (LARGEN et al. 1974). The record in the Beletta Forest is the second documented locality of *Laephotis wintoni* in the country.

Ecological remarks: According to our observations conducted on specimens, some of which were collected afterwards, this species is a slowly-flying aerial insectivore, hunting low over the undergrowth and bushes. Weak teeth with unworn cusps in our specimens suggest that *Laephotis* possibly consumes soft-bodied prey.

Glauconycteris variegata (Tomes, 1861)

Material: Godare Forest, Dushi Area, Yamboshi River, 10-12 October 2000, 1 adult female and 1 adult male (1 in alcohol, 1 skin with skull, ZMUM S-168895-896).

Distribution remarks: This is the third record of *G. variegata* in Ethiopia, but the new locality is not very far from Gambela, one of the previous records (LARGEN et al. 1974).

Scotophilus dinganii (A. Smith, 1833)

Material: Koi River, 37 km SW of Bebeka, 10-12 March 1999, 7 adult females, 1 adult male; Godare Forest, Dushi Area, Yamboshi River, 7-13 October 2000, 2 adult females, 6 males (14 in alcohol, 2 skins with skulls, ZMUM S-167229-234, 167282-283, 168973-980).

Comparative material: *Scotophilus leucogaster* (Cretzschmar, 1826): North Africa, locality and date unknown, 1 female (1 in alcohol, ZMUM S-108968).

Taxonomical remarks: Yellow-bellied, middle-sized *Scotophilus* from Ethiopia were previously referred to as *S. nigrita* (Schreber, 1774) (e.g. LARGEN et al. 1974; KINGDON, 1974), but ROBBINS (1978) established that *S. nigrita* was the prior synonym of the larger species, *S. gigas* Dobson, 1875, and that the smaller species should be referred to as *S. dinganii*. *Scotophilus nigrita* has not yet been recorded in Ethiopia, but *S. dinganii* is thought to be abundant and also the most common species of *Scotophilus* in this country (YALDEN et al. 1996).

With respect to all of the external and cranial parameters which we measured, our specimens resemble *S. dinganii* (FA 49.0-52.5 mm, CM3 6.4-7.1 mm, MM 8.3-8.8 mm vs. 48.0-59.4 mm, 6.4-7.5 mm and 8.1-9.8 mm, respectively) as described by ROBBINS et al. (1985), with the exception that one individual (S-168978) has an abnormally short forearm (45.3 mm). All of them had yellow ventral pelage, while *S. leucogaster* which is similar in size and also known from Ethiopia (YALDEN et al. 1996), lacks any trace of yellow in its ventral pelage (ROBBINS et al. 1985). Condylo-basal length of measured skulls is slightly larger than in *S. leucogaster* (17.4-19.0 mm in our specimens vs. 16.6-17.4 mm in *S. leucogaster* and 17.2-20.2 mm in *S. dinganii*, sensu ROBBINS et al. 1985). Our specimens were larger than *S. viridis* (condylo-basal length 15.5-17.4 mm, CM3 5.6-6.4 mm), which is the only other yellow-bellied *Scotophilus* known from Ethiopia. *Scotophilus nux*, which is known from Kenya and therefore likely to occur in southern Ethiopia, is larger than *S. dinganii* (FA exceed 55 mm) and has dark brownish ventral pelage (ROBBINS et al. 1985).

Miniopterus natalensis (A. Smith, 1834)

Material: Bale Mountains National Park, Harenna Forest, 26 December 1995, 1 adult male; left slope of the Godjeb River Valley, 16 March 1998, 1 adult male (1 in alcohol with extracted skull, 1 skin with skull, ZMUM S-165532, 165960).

Taxonomic remarks: According to LARGEN et al. (1974) the form previously recorded in Ethiopia is *M. schreibersii arenarius* Heller, 1912. Based on multivariate statistics, PETERSON et al. (1995) showed that *M. na-*

talensis is distinct from *M. schreibersii* (thus confirming the opinion of O'SHEA & VAUGHAN [1980] and KOOPMAN [1994]), and *arenarius* is considered to be a subspecies of *M. natalensis*. Therefore, we tentatively treat our specimens as *M. natalensis*.

Ecological remarks: The specimen from the Harenna Forest was netted on the edge of a large clearing in the *Schefflera-Hagenia* forest belt. The second individual was captured in riverine *Ficus* forest.

***Miniopterus africanus* Sanborn, 1936**

Material: Bale Mountains National Park, Harenna Forest, 29 December 1995, 1 adult female; Bale Mountains National Park, Dinshu Hill, 12 December 1995, 1 adult female (2 skins with carcasses in alcohol, 1 skull, ZMUM S-164905, 165352).

Taxonomic remarks: Our specimens have relatively pale greyish-brown pelage coloration, which corresponds to that of *M. inflatus africanus*. This form previously recorded from Ethiopia (LARGEN et al. 1974) was considered by PETERSON et al. (1995) as a full species distinct from *M. inflatus*.

Ecological remarks: Many animals were observed rapidly flying through the openings on the Dinshu Hill near the headquarters of the Bale Mountains National Park. They appeared every evening around sunset, and flew in the direction of the river valley, ca. 8 to 15 meters above ground. In the Harenna Forest *Miniopterus* (probably of both species) were observed hunting over forest openings and near the canopy edges (one individual was captured near the canopy of large *Hagenia*; however, hunting bats kept some distance from trees and other obstacles). Most of our observations were made in relatively high-altitude forest belts. Yet, mummified dead individuals of the species were found under the Shawe bridge (1935 m ASL), showing the possibility of *M. africanus* inhabiting humid evergreen forest.

***Mops (Xiphonycteris) nanulus* J. A. Allen, 1917**

Material: Koi River, 37 km SW of Bebeka, 10-11 March 1999, 2 adult females, 2 adult males (2 in alcohol, 2 skins with skulls, ZMUM S-167217-218, 167286, 167290).

Distribution remarks: This new record is the second documented locality of this species in Ethiopia, however, not very far from the previously known site in Gambela (LARGEN et al. 1974). Outside Ethiopia, *M. nanulus* is widely distributed throughout West and Central Africa in the zone of moist tropical forests (KINGDON 1974; KOOPMAN 1994).

***Chaerephon pumila* (Cretzschmar, 1826)**

Material: Western Oromia, Welkite, 02 March 1999, 1 subadult male; Vanzaye, shore of the Gumara River, 26 November 2001, 13 adult females, 5 adult males (15 in alcohol, 4 skins with skulls, ZMUM S-167291, 172751–768).

Comparative material: *Chaerephon pumila*: Sudan, White Nile, Jebelein, October 1963, 9 females, 11 males(20 in alcohol, 10 skulls extracted, ZMUM S-103182-201).

Taxonomic remarks: About 15 taxa have been described in this size class of *Chaerephon* (VAN CAKENBERGHE et al. 1999), emphasizing the high level of variability which probably is of geographic nature. ROSEVEAR (1965) divided this species into four forms, including *Tadarida pumila* itself with dark wing membranes and body sides, and *T. limbata* Peters, 1852 with white flanks of the body and pale wing membranes. PETERSON et al. (1995) raised *T. (Chaerephon) leucogaster* to specific rank and regarded *T. limbata* as its subspecies. Nevertheless, specimens intermediate between the two coloration types were found in samples from the Democratic Republic of the Congo (VAN CAKENBERGHE et al. 1999). The specimen from Welkite has stripes of white fur on the underwings near the body sides and translucent wing membranes, which is a characteristic of the "*limbata*" coloration type and also *C. nigeriae* (FENTON 1975). Specimens from Vanzaye possess similar stripes and also relatively light-coloured wings and, in some individuals, a whitish area in the middle of belly. The latter feature is a characteristic of *C. major* (ROSEVEAR 1965) and *C. leucogaster* (PETERSON et al. 1995). The latter authors, though, mentioned that coloration of *C. pumila* is highly variable and Ethiopian specimens may possess light wing membranes. LARGEN et al. (1974) treated Ethiopian *C. pumila* as the nominative subspecies, the same as inhabiting Sudan (KOOPMAN 1994). According to PETERSON et al. (1995) *C. pumila* inhabits the eastern part of Ethiopia while *C. leucogaster* occurs in the western part. All the Ethiopian specimens distinctly differ from available specimens from Sudan in having larger skulls (TLS 17.0–17.5 mm, CM3 6.2–6.6 mm vs. TLS 15.4–16.7 and CM3 5.6–6.0 mm in Sudanese specimens) and smaller and more shallow basisphenoid pits (which is character of *C. major* and *C. leucogaster*). The Ethiopian specimens in our possession are also larger than *C. pumila* from Congo (VAN CAKENBERGHE et al. 1999) and *C. leucogaster* from Madagascar (PETERSON et al. 1995) and look somewhat intermediate between *C. pumila* and *C. major*. However, in external measurements they correspond with *C. pumila* (ROSEVEAR 1965; KINGDON 1974) and are smaller than *C. major* and particularly than *C. nigeriae*. So, due to this confusing mix of features, we suggest to regard our specimens as *C. pumila*, until the investigation of comparative material of other *Chaerephon* species.

Ecological remarks: *C. pumila* is one of the most common African molossids, often abundant in various buildings (KINGDON 1974). The specimen from Welkite was taken in a small colony of at least 15 individuals, which roosted in a loft of the hotel house. Specimens from Vanzaye came from a large colony, also roosting in a hotel building.

4. DISCUSSION

The present collection provides important new information about the chiropteran fauna of Ethiopia. New collection localities significantly extend the previously known distribution ranges of some species (*Stenonycteris lanosus*, *Lissonycteris angolensis*, *Hypsignathus monstrosus*, *Micropteropus pusillus*, *Nycteris thebaica*, *Triaenops persicus*, *Myotis scotti*, *M. welwitschii*, *Pipistrellus rusticus*, and *Laephotis wintoni*) in the country. Furthermore, *Myonycteris torquata* and *Pipistrellus aero* are recorded in Ethiopia for the first time. Our study of the collection leaves a number of problems like the correct identification of *Neoromicia* cf. *guineensis* and *Hypsugo* sp.; the latter indicates the presence of a further species in Ethiopia. The absence of high-flying, aerial-hawking bats (e.g. *Taphozous* and *Otomops*) in the present collection could be a consequence of the limited number of capture methods used. Therefore, the potential for finding species new to the country might be relatively higher for this ecological form compared with others.

In May 1993, Ethiopia's former northern province became the independent nation of Eritrea. Bats which have been recorded from that area, but not from within the present boundaries of Ethiopia, are *Barbastella leucomelas* (Cretzschmar, 1826), *Tadarida aegyptiaca* (E. Geoffroy, 1818), *Mops midas* (Sundevall, 1843), *Rhinopoma macinnesi* Hayman, 1937, and *Taphozous nudiventris* Cretzschmar, 1830. Therefore, these species must be excluded from the faunal list of Ethiopia as it is defined today. However, the last two species have been recorded in Sudan close to the Ethiopian border (KOOPMAN 1975), and they almost certainly occur in Ethiopia. The checklist of bats for Ethiopia, as defined today, comprises 77 species (see Appendix 1).

Among all localities studied, only two (Harenna and Beletta) were intensively examined during our long-term survey. In addition, some records were reported for the former locality as a result of the Harenna Forest Expedition (YALDEN 1988). As these two localities (situated at similar elevations on opposite sides of the Rift Valley) represent Afromontane forest, we can make some notes about the bat community of this environment. These remarks should be regarded as preliminary, however they may be useful for further studies in this field. Both the Harenna and Beletta Forests have impoverished bat faunas (10 and 9 species, respectively) compared with those of lower Ethiopian localities (e.g. 29 species in Gambela). This is in agreement with the general conclusion about a gradual decline of bat species richness with elevation (PATTERSON et al. 1996). Three Megachiroptera species (*Rousettus aegyptiacus, Stenonycteris lanosus* and *Lissonycteris angolensis*) were found in both montane forests. The absence of *Epomophorus gambianus* in the Harenna Forest can be explained zoogeographically by taking into account the more eastern and isolated position of this forest, and the apparent absence of *E. gambianus* from the whole area east of the Ethiopian Rift Valley. In contrast, the assemblages of microbats in the Harenna and Beletta Forests appear to share no common species at all. However, it is very likely that the species lists for these two forests are incomplete. For example, the echolocation calls of some bats, presumably of the genus *Myotis*, were recorded in the Harenna Forest with the bat detector. However, although further investigation might reveal the presence of additional species whose occurrence could reduced the difference between the microbat faunas of these two forests, it is nevertheless obvious that the microbat faunas of these forests are very distinct. This could indicate that these local faunas contain species which have been recruited relatively recently from adjacent altitudinal zones, and therefore represent random rather than structured patterns of species composition. Indeed, the species assemblages of these montane forests show quite incomplete ecological and morphological structuring. Both communities share only two eco-morphological forms: manoeuvrable, moderately fast-flying aerial foragers (*Hypsugo, Neoromicia* and *Myotis*) and cluttered-space aerial foragers / perch hunters (*Plecotus* in Harenna and *Laephotis* in Beletta). Slow-flying, manoeuvrable species (such as *Rhinolophus*) which combine aerial foraging with gleaning in cluttered environments, and open-space fast-flying aerial foragers (such as *Miniopterus*), were found only in Harenna. Conversely, *Myotis welwitschii* which is a ground-gleaner, was found only in Beletta. No water-gleaners have been recorded in either of these forests, probably because the forest streams are too small and fast-flowing. Practically all Microchiroptera species from the montane forests do not belong to specialised forest forms. The exceptions are two species, *Myotis scotti* and *Plecotus balensis*, currently considered to be the only bats endemic to Ethiopia. Both these species, being isolated members of essentially Palaearctic taxa (subgenus *Selysius* and *Plecotus*, respectively), are putative derivatives of Palaearctic lineages. It is noteworthy, however, that the result of the recent molecular studies of the genus *Myotis* (RUEDI & MAYER 2001) demonstrated that its subgeneric structure requires complete revision. Therefore, the true position of *Myotis scotti* and its relationships with Palaearc-

tic species needs further review. Among other small mammals (Insectivora and Rodentia), most of the species endemic to Ethiopia have clearly evolved from Afrotropical ancestors (YALDEN & LARGEN 1992; YALDEN et al. 1996).

In Ethiopia, the most important impact on the bat populations is the destruction of forests and woodlands by fire, tree felling and intensive agricultural activities. The most rich and diverse bat fauna of the country is formally protected by the Gambela National Park. Regrettably, this park exists rather nominally, and harsh climatic conditions, tropical malaria and tsetse-fly are still the main factors providing conservation of this unique area. Afromontane forests are the most endangered environment of the country because of their rapid and massive destruction. Despite its impoverished species composition, the bat fauna of this habitat comprises both bats endemic to Ethiopia (*Myotis scotti* and *Plecotus balensis*) and some rare and sporadically distributed species (*Stenonycteris lanosus*, *Myotis welwitschii* and *Laephotis wintoni*). Among all Ethiopian montane forests, only the Harenna Forest is protected as a part of the Bale Mountains National Park. Fortunately, this protected area encompasses the extremely small currently known distribution range of *Plecotus balensis* which should be tentatively classified as Vulnerable (criterion D-2) according to the categories of the IUCN Red List. A further survey is needed to determine the status and conservation requirements of this recently described endemic species. At the present time, four mammalian species (*Plecotus balensis, Crocidura harenna* Hutterer & Yalden, 1990, *Cercopithecus djaudjaueusis* Neumann, 1902, and an undescribed species of *Mus* - for details see LAVRENCHENKO 2000) are known to be endemic to the Harenna Forest. This number is remarkable for such a relatively small geographic area, and indicates that the Harenna Forest is one of the most important sites for biological diversity in Ethiopia. Therefore, this forest deserves special protection and conservation.

Acknowledgements. We wish to thank Ato Kidanemariam Jembere at the Ethiopian Science and Technology Commission for support in the field work organisation. Dr. A. A. Darkov coordinated field operations. We are indebted to the Ethiopian Wildlife Conservation Organization (EWCO) for permission to export specimens. The work of L. A. Lavrenchenko in the Harrison Institute (Centre for Biodiversity Research), Sevenoaks (Kent) was supported by a Visiting Grant from the Royal Society (London) in 1999. We especially thank Dr. Victor Van Cakenberghe and Dr. Paul Bates for examining critical specimens. Vladimir S. Lebedev and Dr. Alexey V. Borissenko rendered their assistance during the preparation of the manuscript. Finally, we acknowledge the manuscript review undertaken by Dr. Meredith Happold (Australian National University); her efforts and thoughtful comments improved our interpretation of the data.

REFERENCES

ALVAREZ, I., JUSTE, J. B., TABARES, E., GRRIDO-PERTIERA, A., IBANEZ, C. & BAUTISTA, J. M. (1999): Molecular phylogeny and morphological homoplasy in fruitbats. Molecular Biology and Evolution **18**: 1061-1067.

BAETEN, B., VAN CAKENBERGHE, V. & DE VREE, F. (1984): An annotated inventory of a collection of bats from Rwanda (Chiroptera). Revue zoologique Africaine **98**: 183-196.

BERGMANS, W. (1989): Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 2. The genera *Micropteropus* Matschie, 1899, *Epomops* Gray, 1870, *Hypsignathus* H. Allen, 1861, *Nanonycteris* Matschie, 1899 and *Plerotes* Andersen, 1910. Beaufortia. **39**(4): 89-153.

BERGMANS, W. (1997): Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 5. The genera *Lissonycteris* Andersen, 1912, *Myonycteris* Matschie, 1899 and *Megaloglossus* Pagenstecher, 1885; General remarks and conclusions; Annex; Key to all species. Beaufortia. **47**(2): 11-90.

CLAESSEN, C. J. & DE VREE, F. (1991): Systematic and taxonomic notes on the *Epomophorus anurus-labiatus-minor* complex with the description of a new species (Mammalia: Chiroptera: Pteropodidae). Senkenbergiana biologica **71**: 209-238.

CORBET, G. B. (1978): The Mammals of the Palaearctic Region: A Taxonomic review. British Museum (Natural History), London.

COTTERILL, F. P. D. (2002): A new species of horseshoe bat (Microchiroptera: Rhinolophidae) from south-central Africa: With comments on its affinities and evolution, and the characterization of rhinolophid species. Journal of Zoology (Lond.) **256**: 165-179.

CSADA, R. (1996): *Cardioderma cor*. Mammalian Species **519**: 1-4.

EGER., J. L. & SCHLITTER, D. A. (2001): A new species of *Glauconycteris* from West Africa (Chiroptera: Vespertilionidae). Acta Chiropterologica **3**(1): 1-10.

FAHR, J., VIERHAUS, H., HUTTERER, R. & KOCK, D. (2002): A revision of the Rhinolophus maclaudi species group with description of a new species from West Africa (Chiroptera: Rhinolophidae). Myotis **40**: 95-126.

FAHR, J. & EBIGBO, N. M. (2003): A conservation assessment of the bats of the Simandou Range, Guinea, with the first record of *Myotis welwitschii* (Gray, 1866) from West Africa. Acta Chiropterologica **5**: 125-141.

FENTON, M. B. (1975): Observation on the biology of some Rhodesian bats, including a key to the Chiroptera of Rhodesia. Royal Ontario Museum, Life Sciences Contributions **104**: 1-27.

HAPPOLD, D. C. D. & HAPPOLD, M. (1990): Reproductive strategies of bats in Africa. Journal of Zoology (Lond.) **222**: 557-583.

HAYMAN, R. W. & HILL, J. E. (1971): Order Chiroptera. in: MEESTER, J. & SETZER, H. W. (eds.): The Mammals of Africa. An Identification Manual. Part 2. 1-73. Smithsonian Institution Press, Washington, D. C.

HELLER, K.-G., VOLLETH, M. & KOCK, D. (1994): Notes on some vespertilionid bats from the Kivu region, Central

Africa (Mammalia: Chiroptera). Senckenbergiana biologica **74**: 1-8.

HILL, J. E. (1974): A review of *Laephotis* Thomas, 1901 (Chiroptera: Vespertilionidae). Bulletin of British Museum (Natural History) Zoology **27**: 73-82.

HILL, J. E. & HARRISON, D. L. (1987): The baculum in the Vespertilioninae (Chiroptera: Vespertilionidae) with a systematic review, a synopsis of *Pipistrellus* and *Eptesicus*, and the description of a new genus and subgenus. Bulletin of the British Museum (Natural History) Zoology **52**: 225-305.

HILL, J. E. & MORRIS, P. (1971): Bats from Ethiopia collected by the Great Abbai Expedition, 1968. Bulletin of the British Museum (Natural History) Zoology **21**: 27-49.

JUSTE, J. B., IBÁÑEZ, C. & MACHORDOM, A. (1997): Evolutionary relationships among the African fruit bats: *Rosettus egyptiacus*, *R. angolensis*, and *Myonycteris*. Journal of Mammalogy **78**: 766-774.

JUSTE, J. B., ALVAREZ, Y., TABARÉS, E., GARRIDO-PERTIERRA, A., IBÁÑEZ, C. & BAUTISTA, J. M. (1999): Phylogeography of African fruitbats (Megachiroptera). Molecular Phylogenetics and Evolution **13**: 596-604.

KEARNEY, T., VOLLETH, M., CONTRAFATTO, G. & TAYLOR, P. J. (2002): Systematic implications of chromosome GTG-band and bacula morphology for Southern African *Eptesicus* and *Pipistrellus* and several other species of Vespertilioninae (Chiroptera: Vespertilionidae). Acta Chiropterologica **4**: 55-76.

KEIFER, A., VEITH, M. (2001): A new species of long-eared bat from Europe (Chiroptera, Vespertilionidae). Myotis **39**: 5-16.

KINGDON, J. (1974): East African Mammals. An Atlas of Evolution in Africa. Vol. II, part A (Insectivores and Bats). Academic Press, London & New York.

KOCK, D. (2001): Identity of the African *Vespertilio hesperida* Temminck 1840 (Mammalia, Chiroptera, Vespertilionidae). Senckenbergiana biologica **81**: 277-283.

KOCK, D., CSORBA, G. &. HOWELL, K. M (2000): *Rhinolophus maendeleo* n. sp. from Tanzania, a horseshoe bat noteworthy for its systematic and biogeography (Mammalia, Chiroptera, Rhinolophidae). Senckenbergiana biologica **80**: 233-239.

KONSTANTINOV, O. K., PEMA, A. I., LABZIN, V. V. & FARAFONOVA, G. V. (2000): Records of bats from Middle Guinea, with remarks on their natural history. Plecotus et al. **3**: 129-148.

KOOPMAN, K. F. (1965): Status of forms described or recorded by J. A. Allen in "The American Museum Congo Expedition Collection of Bats". American Museum Novitates **2219**: 1-34.

KOOPMAN, K. F. (1975): Bats of the Sudan. Bulletin of the American Museum of Natural History **154**: 353-444.

KOOPMAN, K. F. (1993): Order Chiroptera. Pp. 137-241 in: WILSON, D. E. & REEDER, D. M. (eds.): Mammal Species of the World. A Taxonomic and Geographic Reference. Smithsonian Institution Press, Washington & London.

KOOPMAN, K. F. (1994): Chiroptera: Systematics. Handbuch der Zoologie. Mammalia. Vol.VIII (60). Walter de Gruyter, Berlin.

KRUSKOP, S. V. & LAVRENCHENKO, L. A. (2000): A new species of long-eared bat (*Plecotus*; Vespertilionidae, Mammalia) from Ethiopia. Myotis **38**: 5-17.

LARGEN, M. G., KOCK, D. & YALDEN, D. W. (1974): Catalogue of the mammals of Ethiopia. I. Chiroptera. Monitore zoologica Italiano (N.S.), suppl. **5**: 221-298.

LAVRENCHENKO, L. A. (2000): The mammals of the isolated Harenna Forest (southern Ethiopia): structure and history of the fauna. Pp. 223-231 in: RHEINWALD, G. (ed.): Isolated Vertebrate Communities in the Tropics. Bonner zoologische Monographien **46**.

LAVRENCHENKO, L. A. (2003): A contribution to the systematics of *Desmomys* Thomas, 1910 (Rodentia, Muridae) with the description of a new species. Bonner zoologische Beiträge **50**: 313-327.

MENU, H. (1987): Morphotypes dentaires actuels et fossiles des chiroptères vespertilioninés. 2ème partie: implications systématiques et phylogéniques. Palaeovertebrata **17**: 77-150.

MCBEE, K., SCHLITTER, D. A. & ROBBINS, L. R. (1987): Systematics of African bats of the genus *Eptesicus* (Mammalia: Vespertilionidae). 2. Karyotypes of African species and their generic relationships. Annals of the Carnegie Museum **56**: 213-222.

O'SHEA, T. J. & VAUGHAN, T. A. (1980): Ecological observations on an East African bat community. Mammalia **44**: 485-496.

PATTERSON, B. D., PACHECO, V. & SOLARI, S. (1996): Distributions of bats along an elevational gradient in the Andes of south-eastern Peru. Journal of Zoology (London) **240**: 637-658.

PETERSON, R. L. (1971): Notes on the African long-eared bats of the genus *Laephotis* (family Vespertilionidae). Canadian Journal of Zoology **49**: 885-888.

PETERSON, R. L., EGER, J. L. & MITCHELL, L. (1995): Chiroptères. Faune de Madagascar **84**: 1-204.

RAUTENBACH, I. L., FENTON, M. B. & BRAACK, L. E. O. (1985): First records of five species of insectivorous bats from the Kruger National Park, South Africa. Koedoe **28**: 73-80.

ROBBINS, C. B. (1978): Taxonomic identification and history of *Scotophilus nigrita* (Schreber) (Chiroptera: Vespertilionidae). Journal of Mammalogy **59**: 212-213.

ROBBINS, C. B., DE VREE, F. & VAN CAKENBERGHE, V. (1985): A systematic revision of the African bat genus *Scotophilus* (Vespertilionidae). Annales du Musée Royal de l'Afrique Centrale (Sciences zoologiques) **246**: 53-84.

ROBERTS, A. (1926): Some new South African mammals and some changes in nomenclature. Annals of the Transvaal Museum **11**: 245-263.

ROMAGNOLI, M. L. & SPRINGER, M. S. (2000): Evolutionary relationships among Old World fruitbats (Megachiroptera: Pteropodidae) based on 12S rRNA, tRNA Valine, and 16S rRNA Gene Sequences. Journal of Mammalian Evolution **7**: 259-284.

ROSEVEAR, D. R. (1965): The Bats of West Africa. Trustees British Museum (Natural History), London.

RUEDI, M. & MAYER, F. (2001): Molecular systematics of bats of the genus *Myotis* (Vespertilionidae) suggests deterministic ecomorphological convergences. Molecular Phylogenetics and Evolution **21**: 436-448.

SPITZENBERGER, F., HARING, E. & TVRICOVIĆ, N. (2002): *Plecotus microdontus* (Mammalia, Vespertilionidae), a new bat species from Austria. Natura Croatica **11**: 1-18.

SPITZENBERGER, F., STRELKOV, P. & HARING, E. (2003): Morphology and mitochondrial DNA sequences show that *Plecotus alpinus* Kiefer & Veith, 2002 and *Plecotus microdontus* Spitzenberger, 2002 are synonyms of *Plecotus macrobullaris* Kusjakin, 1965. Natura Croatica **12**: 39-53.

STRELKOV, P. P. (1989): New data on the structure of baculum in Palaearctic bats. I. The genera *Myotis*, *Plecotus*, and *Barbastella*. Pp. 87-94 in: HANAK, V., I. HORACEK & GAISLER, J. (eds.): European Bat Research 1987. Charles University Press, Praha.

TATE, H. H. (1941): Results of the Archbold expeditions. 35. A review of the genus *Hipposideros* with special reference to Indo-Australian species. Bulletin of the American Museum of Natural History **78**: 353-393.

VAN CAKENBERGHE, V. & DE VREE, F. (1993): Systematics of African *Nycteris* (Mammalia: Chiroptera). Part II. The *Nycteris hispida* group. Bonner zoologische Beiträge **44**: 299-332.

VAN CAKENBERGHE, V., DE VREE, F. & LEIRS, H. (1999): On a collection of bats (Chiroptera) from Kikwit, Democratic Republic of the Congo. Mammalia **63**: 291-322.

VAUGHAN, T. A. (1976): Nocturnal behaviour of the African False Vampire Bat (*Cardioderma cor*). Journal of Mammalogy **57**: 227-248.

VOLLETH, M., BRONNER, G., GOPFERT, M. C., HELLER, K.–G., VON HELVERSEN, O. & YONG, H.–S. (2001): Karyotype comparison and phylogenetic relationships of *Pipistrellus*–like bats (Vespertilionidae: Chiroptera; Mammalia). Chromosome Research **9**: 25-46.

VOLLETH, M. & HELLER, K.–G. (1994): Phylogenetic relationships of vespertilionid genera (Mammalia: Chiroptera) as revealed by karyological analysis. Zeitschrift für zoologische Systematik und Evolutionsforschung **32**: 11-34.

YALDEN, D. (1988): Small mammals in the Harenna Forest, Bale Mountains National Park. Sinet: Ethiopian Journal of Science **11**: 41-53.

YALDEN, D. W. & LARGEN, M. J. (1992): The endemic mammals of Ethiopia. Mammal Review **22**: 115-150.

YALDEN, D. W., LARGEN, M. J., KOCK, D. & HILLMAN, J. C. (1996): Catalogue of the mammals of Ethiopia and Eritrea. 7. Revised checklist, zoogeography and conservation. Tropical Zoology **9**: 73-164.

Authors' addresses: Leonid A. LAVRENCHENKO, Petr N. MOROZOV, A. N. Severtsov Institute of Ecology and Evolution RAS, Leninsky pr. 33, Moscow, 119071 Russia; Sergei V. KRUSKOP, Zoological museum of Moscow state university, Ul. Bolshaya Nikitskaya 6, Moscow, 125009 Russia, e-mail: selysius@mail.ru

Received: 10.11.2003
Returned for Revision: 23.12.2003
Accepted: 24.03.2004
Corresponding editor: G. PETERS

Tab. 1. Selected cranial measurements (mm) of some of the Ethiopian bats collected in this study. See Material and Methods for abbreviations of measurements.

species (n)		TLS	CCL	POC	MW	CC	MM	CM	ML
Epomophorus gambianus (3)	mean	46,50	44,39	10,35	16,78	8,78	12,70	16,89	36,86
	min	44,50	42,3	10,2	16,0	8,55	12,4	16,3	35,5
	max	48,85	46,6	10,5	17,2	9,18	13,1	17,6	38,5
Hypsignathus monstrosus (1)		60,60	56,45	10,22	20,20	12,73	19,71	21,44	50,54
Lissonycteris angolensis (7)	mean	39,44	36,98	8,50	14,29	7,33	11,92	14,96	30,33
	min	38,70	36,0	7,69	13,8	7,00	11,2	14,5	30,0
	max	40,23	37,6	9,01	14,8	7,66	12,3	15,6	30,8
	st.div.	0,59	0,63	0,41	0,29	0,27	0,40	0,36	0,31
Myonycteris torquata (1)		35,39	32,74	8,97	13,46	6,85	10,81	13,49	27,35
Micropteropus pusillus (3)	mean	29,99	28,13	8,71	12,56	6,04	9,95	9,59	23,03
	min	29,25	27,7	8,43	12,2	5,78	9,67	9,22	22,4
	max	30,85	29,1	8,98	12,8	6,31	10,50	10,10	24,1
Rousettus aegyptiacus (4)	mean	40,99	38,02	8,85	15,75	8,36	12,38	16,23	32,43
	min	39,5	36,1	8,11	14,9	7,96	11,9	15,2	30,9
	max	41,9	39,5	9,82	16,6	8,65	12,9	16,7	33,8
	st.div.	1,04	1,45	0,75	0,75	0,30	0,44	0,70	1,18
Stenonycteris lanosus (9)	mean	41,63	37,55	9,17	15,45	8,55	12,41	14,87	31,97
	min	40,50	36,0	8,26	14,8	8,15	11,6	14,3	30,8
	max	42,13	38,6	10,00	15,9	9,20	15,8	16,6	33,0
	st.div.	0,50	0,74	0,56	0,30	0,39	1,30	0,70	0,69
Rhinolophus clivosus (1)		20,87	18,04	2,91	9,83	5,59	7,69	7,65	14,02
Hipposideros ruber (3)	mean	19,79	17,42	3,25	10,40	4,83	7,25	6,99	12,73
	min	19,55	17,1	3,14	10,3	4,76	7,18	6,96	12,7
	max	20,00	17,7	3,41	10,5	4,87	7,33	7,04	12,8
Hipposideros cf. caffer (3)	mean	17,59	15,00	2,79	9,42	3,62	6,15	5,83	10,77
	min	17,35	14,8	2,71	9,37	3,50	6,08	5,65	10,6
	max	17,76	15,2	2,86	9,46	3,75	6,28	5,97	11,0
Triaenops persicus (1)		20,20	17,66	2,73	8,94	5,41	6,80	7,03	12,76
Myotis scotti (3)	mean	14,70	13,23	3,37	7,43	3,49	5,99	5,47	10,52
	min	14,30	12,8	3,35	7,30	3,38	5,86	5,29	10,0
	max	15,07	13,8	3,41	7,62	3,69	6,12	5,69	11,1
Myotis welwitschii (2)	mean	20,03	18,10	4,97	10,08	5,76	8,69	7,79	15,37
Plecotus balensis (1)		16,43	14,64	3,66	8,92	3,54	5,76	5,42	10,15
Hypsugo sp. (1)		11,94	10,63	3,34	6,68	3,71	4,91	4,14	8,39
Pipistrellus hesperidus (9)	mean	13,34	12,43	3,78	7,69	4,30	5,80	4,87	9,74
	min	12,80	12,1	3,71	7,51	4,13	5,60	4,74	9,44
	max	3,62	12,9	3,87	7,79	4,52	6,25	5,12	10,20
	st.div.	0,32	0,27	0,05	0,09	0,12	0,19	0,12	0,23
Pipistrellus cf. aero (6)	mean	12,77	11,78	3,46	7,18	4,02	5,50	4,66	9,26
	min	12,71	11,4	3,29	6,89	3,87	5,33	4,48	9,03
	max	12,82	12,2	3,66	7,46	4,21	5,75	4,73	9,65
	st.div.	0,08	0,25	0,12	0,23	0,13	0,20	0,10	0,22
Pipistrellus rusticus (1)		11,31	10,63	3,53	6,88	3,73	4,92	3,94	8,36
Laephotis wintoni (2)	mean	16,05	15,12	3,63	8,00	4,39	5,44	5,04	10,88
Glauconycteris variegata (1)		13,20	13,20	4,70	9,07	4,45	6,64	4,71	9,99
Scotophilus dinganii (6)	mean	19,38	17,75	4,72	11,23	6,58	8,61	6,68	13,96
	min	18,53	17,2	4,65	10,7	6,33	8,29	6,46	13,6
	max	20,29	18,6	4,82	11,8	6,95	8,82	7,12	14,6
	st.div.	0,72	0,53	0,07	0,41	0,23	0,20	0,24	0,35

species (n)		TLS	CCL	POC	MW	CC	MM	CM	ML
Miniopterus natalensis (2)	mean	14,71	13,42	3,74	8,27	4,19	5,86	5,60	10,39
Miniopterus africanus (1)		16,73	15,31	4,14	9,03	4,95	7,18	6,55	12,01
Mops nanulus (2)	mean	16,23	14,76	3,78	10,09	4,42	7,62	6,35	11,30
Chaerephon pumila (3)	mean	17,22	15,25	4,08	10,12	4,39	7,77	6,41	11,76
	min	16,98	15,0	4,04	9,89	4,10	7,66	6,23	11,6
	max	17,45	15,5	4,16	10,40	4,55	7,95	6,57	11,9

Tab. 2. Selected external measurements (mm) and weight (g) of some of the Ethiopian bats collected in this study. See Material and Methods for abbreviations of measurements.

Species (n)		B	T	FA	EAR	HF	W
Epomophorus gambianus (11)	min-max	123-154	0-12	70,2-88,2	18,3-23,0	19,2-26,1	69-111
	mean	134,0	6,1	81,4	21,2	21,4	86,3
	S. D.	11,3	3,9	5,2	1,2	2,4	13,2
Hypsignathus monstrosus (2)	min-max	180-193		115,6-117,9	30,4-32,2	32,0-38,6	
	mean	186,5	0,0	116,8	31,3	35,3	200,0
Lissonycteris angolensis (24)	min-max	100-126	5-9,4	69,0-81,0	18,2-25,0	15,3-20.0	47-76
	mean	112,9	9,4	73,8	21,6	17,7	60,8
	S. D.	6,1	2,5	3,9	1,6	1,5	8,1
Myonycteris torquata (1)		105	8	64,8	22	20	47
Micropteropus pusillus (16)	min-max	70-99		50,2-60,0	13,9-18,0	12,0-15,1	22-31
	mean	86,0	5,7	52,8	16,2	13,9	26,1
	S. D.	7,4		3,3	1,2	1,1	3,2
Rousettus aegyptiacus (8)	min-max	106-143	6-22	76,0-97,5	19,8-22,1	20,0-23,3	56-94
	mean	129,8	14,4	90,0	21,1	21,3	76,0
	S. D.	13,1	5,2	8,9	0,7	1,3	16,6
Stenonycteris lanosus (17)	min-max	118-180	12-35	77,5-92,0	21,0-23,7	18,5-22,5	78-131
	mean	139,4	22,8	87,5	22,1	21,2	105,6
	S. D.	13,2	5,1	3,5	0,9	1,4	17,2
Cardioderma cor (1)		75,0	0,0	56,0	37,0	15,5	
Lavia frons (2)	min-max	60-70	0,0	56,4-57,4	40,0	13,5-13,9	
Nycteris hispida (3)	min-max	41-50	42-45	40,2-41,6	18,8-19,1	8,5-9,6	5,9-6,5
	mean	45,3	43,7	40,9	18,9	8,9	6,2
Nycteris thebaica (1)		48,0	46,0	41,1	26,3	10,1	
Nycteris macrotis (1)		57,0	45,0	45,6	25,2	11,1	10,5
Hipposideros caffer (6)	min-max	48,5-54	28-32	47,8-50,6	14,9-15,6	7,3-13,5	
	mean	51,4	30,3	49,6	15,3	10,0	8,0
	S. D.	2,3	1,6	1,0	0,2	2,0	
Hipposideros rubber (5)	min-max	52,5-61,5	32-37	54,5-57,0	15,3-15,9	7,9-10,4	13,0-14,0
	mean	57,1	35,1	56,1	15,6	9,3	13,5
	S. D.	4,0	1,9	1,0	0,2	0,9	0,7
Triaenops persicus (4)	min-max	57,5-66	33-35	56,4-58,8	9,1-14,1	9,6-10,3	14-17
	mean	61,9	33,7	57,7	11,3	10,0	15,0
	S. D.	3,5	0,8	1,0	2,2	0,3	1,4
Rhinolophus clivosus (1)		54,0	28,0	49,5	21,0	10,1	10,0
Myotis scotti (5)	min-max	44-46	41-47	38,4-41,0	13,0-15,2	6,3-9,1	4,0
	mean	44,7	43,4	39,8	13,8	7,6	4,0
	S. D.	0,8	3,0	1,2	0,9	1,0	
Myotis welwitschii (2)	min-max	63-68	57-57,3	60,2-68,3	18,0-20,0	10,7-11,0	15,0
Plecotus balensis (1)		45,0	48,0	36,3	37,0	17,4	
Neoromicia capensis (3)	min-max	42-43	27-32	29,7-31,4	10,5-11,7	4,7-5,1	4,0
	mean	42,7	30,2	30,5	11,1	4,9	4,0
Neoromicia guineensis (2)	min-max	41-41,5	20,4-23,1	28,7-28,9	10,0-10,1	5,6-6,1	3,0
Hypsugo sp. (1)		40,4	41,2	34,1	10,2	6,0	3,3

Tab. 2. Continuation.

Species (n)		B	T	FA	EAR	HF	W
Pipistrellus hesperidus (10)	min-max	43-48	30-34	33,4-36,1	10,2-11,2	6,5-7,8	
	mean	44,4	31,5	34,6	10,8	7,1	
	S. D.	1,6	1,6	0,9	0,3	0,4	
Pipistrellus aero (8)	min-max	40-49	24-34	30,5-35,0	11,2-12,2	5,2-9,8	4,0-5,0
	mean	45,0	30,7	32,8	11,5	7,0	4,5
	S. D.	2,8	3,3	1,5	0,4	1,4	0,6
Pipistrellus rusticus (6)	min-max	38-48,5	23-34	26,2-32,9	7,0-12,1	3,9-6,2	3,0-4,0
	mean	42,2	26,8	28,3	8,9	5,0	3,7
	S. D.	3,6	4,0	2,4	1,7	1,0	0,6
Laephotis wintoni (2)	min-max	52-53	40,5-42	38,6-39,0	24,8	8,9	6,0-7,0
Glauconycteris variegata (2)	min-max	55,5-57,5	46-51	43,2-44,1	10,7-11,3	8,9-9,6	11,0-14,0
Scotophilus dinganii (16)	min-max	60-78,5	35,5-54	45,3-52,5	13,8-17,8	7,0-13,1	18,0-20,0
	mean	70,9	47,3	50,5	15,2	10,5	18,7
	S. D.	4,7	5,6	1,7	1,0	1,8	1,0
Miniopterus natalensis (2)	min-max	48-57	52,56,5	44,5	11,0-11,3	8,3	9,0
Miniopterus africanus (2)	min-max	57-65,5		49,0-49,8	12,5-13,4	10,3-10,8	6,5
Mops nanulus (4)	min-max	51-54,5	21-25	29,3-31,5	11,5-12,3	6,4-8,3	
	mean	52,9	23,3	30,8	12,0	7,0	
	S. D.	1,6	2,1	1,0	0,3	0,9	
Chaerephon pumila (19)	min-max	55-63	26,5-34,5	38,8-42,3	10,6-17,2	7,6-9,2	
	mean	59,7	29,7	40,5	15,2	8,4	
	S. D.	2,0	2,2	1,1	1,5	0,5	

Appendix 1: Checklist of bat species recorded from Ethiopia

Pteropodidae	
Rousettus aegyptiacus	2,4
Stenonycteris lanosus	2,4,8
Myonycteris torquata	8
Lissonycteris angolensis	2,4,8
Eidolon helvum	2,4
Hypsignathus monstrosus	2,4,8
Epomophorus gambianus	2,4,8
Epomophorus labiatus	2,4
Epomophorus minimus	4
Micropteropus pusillus	1,2,4,8
Rhinopomatidae	
Rhinopoma hardwickei	1,2,4
Emballonuridae	
Taphozous perforatus	1,2,4
Taphozous mauritianus	2,4
Coleura afra	2,4
Nycteridae	
Nycteris thebaica	1,2,4,8
Nycteris hispida	2,4,8
Nycteris aurita	4
Nycteris macrotis	4,8
Nycteris woodi	4
Megadermatidae	
Lavia frons	2,4,8
Cardioderma cor	1,2,4,8
Rhinolophidae	
Rhinolophus clivosus	1,2,4,8
Rhinolophus landeri	1,2,4
Rhinolophus eloquens	6
Rhinolophus hipposideros	1,2,4
Rhinolophus simulator	1,2,4
Rhinolophus blasii	2,4
Rhinolophus fumigatus	1,2,4
Rhinolophus hildebrandtii	2,4
Hipposideridae	
Hipposideros caffer	1,2,4,8
Hipposideros ruber	1,2,4,8
Hipposideros commersoni	2,4
Hipposideros fuliginosus	2,4
Hipposideros megalotis	2,4
Triaenops persicus	1,2,4,8
Asellia tridens	1,2,4
Asellia patrizii	1,2,4
Vespertilionidae	
Kerivoula lanosa	2*,4
Myotis welwitschii	2,4,7,8
Myotis tricolor	2,4
Myotis morrisi	1,2,4
Myotis scotti	2,4,8
Myotis bocagii	4
Plecotus balensis	8
Pipistrellus hesperidus	1**,2**,8
Pipistrellus rusticus	2,4,8
Pipistrellus rueppelli	2,4
Pipistrellus aero	8
Neoromicia(?) nanus	1,2,4
Neoromicia capensis	2,4,8
Neoromicia somalicus	1,2,4
Neoromicia guineensis	2,4,8
Neoromicia tenuipinnis	4
Neoromicia zuluensis	5
Mimetillus moloneyi	2,4
Laephotis wintoni	2,4,8
Nycticeinops schlieffeni	2,4
Scotophilus dinganii	4,8
Scotophilus leucogaster	2,4
Scotophilus viridis	3
Scotoecus hindei	2,4
Scotoecus hirundo	2,4
Glauconycteris variegata	1,2,4,8
Miniopterus africanus	1***,2***,8
Miniopterus natalensis	2****,8
Molossidae	
Otomops martiensseni	1,2,4
Platymops setiger	2,4
Chaerephon pumila	1,2,4,8(?)
Chaerephon leucogaster	5
Chaerephon chapini	4
Chaerephon nigeriae	1,2,4
Chaerephon bivittata	2,4
Chaerephon ansorgei	4
Mops condylurus	2,4
Mops nanulus	2,4,8
Tadarida ventralis	1*****,2,4
Mormopterus acetabulosus	1,2,4

Source of data: 1 – HILL & MORRIS 1971, 2 - LARGEN et al. 1974; 3 - ROBBINS et al. 1985; 4 - YALDEN et al., 1996; 5 - PETERSON et al. 1995; 6 - COTTERILL 2002; 7 – FAHR & EBIGBO 2003; 8 - this study.

* — as *Kerivoula eriophora*; ** — as *Pipistrellus kuhlii fuscatus*; *** — as *Miniopterus inflatus africanus*; **** — as *Miniopterus schreibersi arenarius*; ***** — as *Tadarida africana*.